             3GPP SIP URI Inter-Operator Traffic Leg Parameter

Abstract

   In 3GPP networks, the signaling path between a calling user and a
   called user can be partitioned into segments, referred to as traffic
   legs. Each traffic leg may span networks belonging to different
   operators and will have its own characteristics that can be different
   from other traffic legs in the same call. A traffic leg might be
   associated with multiple SIP dialogs, e.g., in case a Back-to-Back
   User Agent (B2BUA) that modifies the SIP dialog identifier is located
   within the traffic leg.

   This document defines a new SIP URI parameter, 'iotl' (an
   abbreviation for Inter-Operator Traffic Leg). The parameter can be
   used in a SIP URI to indicate that the entity associated with the
   address, or an entity responsible for the host part of the address,
   represents the end of a specific traffic leg (or multiple traffic
   legs).

   The SIP URI 'iotl' parameter defined in this document has known uses
   in 3GPP networks. Usage in other networks is also possible.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
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1. Introduction

   In a 3GPP network, an end-user device can be attached (e.g., using a
   radio access network) to its own operator network (home network)
   [TS.3GPP.24.229] or to another operator's network (visited network)
   [TS.3GPP.24.229]. In the latter case, the user is referred to as a
   roaming user.

   3GPP operator networks are often not connected directly to each
   other. Instead, there might be intermediate networks, referred to as
   3GPP transit networks, between them. Such transit networks act on
   the SIP level or the IP level.

   In 3GPP networks, the signaling path between a calling user and a
   called user can be partitioned into segments, referred to as traffic
   legs. Each traffic leg may span networks belonging to different
   operators and will have its own characteristics that can be different
   from other traffic legs in the same call. A traffic leg might be
   associated with multiple SIP dialogs, e.g., in case a B2BUA [RFC3261]
   that modifies the SIP dialog identifier is located within the traffic
   leg.

   The traffic leg information can be used by intermediary entities to
   make policy decisions related to, e.g., media anchoring, signaling
   policy, insertion of media functions (e.g., transcoder), and
   charging.

   The figure below shows two users (Alice and Bob) and the different
   type of networks that the signaling might traverse. The signaling
   path can be divided into multiple traffic legs, and the type of
   traffic legs depends on how the signaling is routed.

```
Alice -- ORIG HNW +++++ TRANSIT NW +++++ TERM HNW -- Bob
Home           +      +                +    +    +    Home
               +      +++++++++++++++++    +    +
               +                           +    +
               +                           +    +
               +      ++++++++++++++++++++++    +
               +      +             +          +
Alice -- ORIG VNW +++++ TRANSIT NW ++    TERM VNW -- Bob
Visited                                       Visited

ORIG HNW   =      Originating 3GPP Home Network
TERM HNW   =      Terminating 3GPP Home Network
ORIG VNW   =      Originating 3GPP Visited Network
TERM VNW   =      Terminating 3GPP Visited Network
TRANSIT NW =      3GPP Transit Network
```
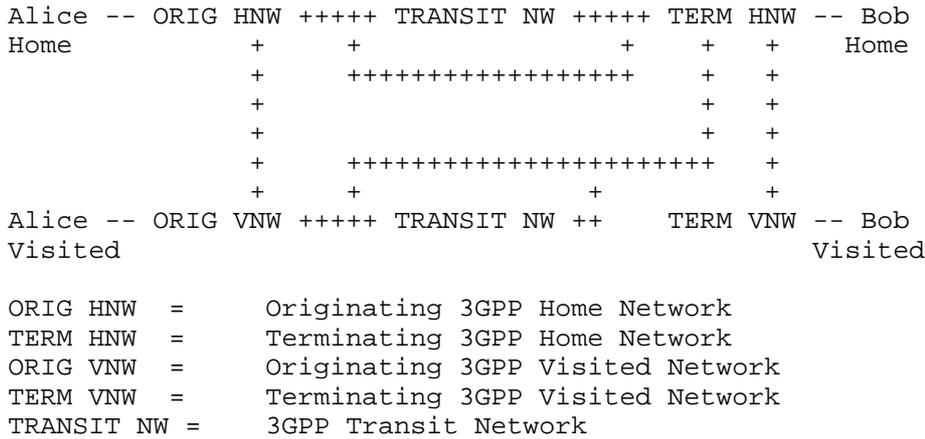
Figure 1: 3GPP Operator Network Roaming Roles

In Figure 1, Alice is a user initiating communication with Bob. Also,
consider the following information:

Alice is attached to an originating network, which is either the home
network of Alice or a visited network (in case Alice is roaming). In
both cases, any originating service is provided by the home network
of Alice.

Bob is attached to a terminating network, which is either the home
network of Bob or a visited network (in case Bob is roaming). In
both cases, any terminating service is provided by the home network
of Bob.

A transit network providing transit functions (e.g., translation of
free phone numbers) may be included between the originating and
terminating networks and between visited and home networks.

This document defines a new SIP URI parameter [RFC3261], 'iotl' (an
abbreviation for Inter-Operator Traffic Leg). The parameter can be
used in a SIP URI to indicate that the entity associated with the
address, or an entity responsible for the host part of the address,
represents the end of a specific traffic leg (or multiple traffic
legs).

This document defines the following 'iotl' parameter values:

o homea-homeb

o homeb-visitedb

o visiteda-homea

o homea-visiteda

o visiteda-homeb

SIP entities that do not support the SIP URI 'iotl' parameter will simply ignore it, if received, as defined in [RFC3261].

2. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

3. Applicability

The SIP URI 'iotl' parameter defined in this document has known uses in 3GPP networks. Usage in other networks is also possible.

4. Traffic Leg Examples

4.1. General

This section describes examples of different types of traffic legs in 3GPP networks.

4.2. Originating Roaming Call

In this case, Alice is located in a visited network. When Alice sends the initial SIP INVITE request for a call, one traffic leg (referred to as the 'visiteda-homea' traffic leg) represents the signaling path between the User Agent (UA) of Alice and the home Serving Call Session Control Function (S-CSCF) [TS.3GPP.24.229] of Alice.

4.3. Terminating Roaming Call

   In this case, Bob is located in a visited network. When the home
   S-CSCF of Bob forwards the initial SIP INVITE request for a call
   towards Bob, one traffic leg (referred to as the 'homeb-visitedb'
   traffic leg) represents the signaling path between the home S-CSCF of
   Bob and the UA of Bob.

4.4. Call from Originating Home to Terminating Home

   In this case, the home S-CSCF of Alice forwards the initial SIP
   INVITE request towards the home S-CSCF of Bob. The signaling path
   between the S-CSCFs represents one traffic leg (referred to as the
   'homea-homeb' traffic leg).

5. 'iotl' SIP URI Parameter

5.1. Usage

   As specified in [RFC3261], when a SIP entity inserts a SIP URI in an
   initial request for a dialog, or in a stand-alone request, the SIP
   URI will be used to route the request to another SIP entity,
   addressed by the SIP URI, or to a SIP entity responsible for the host
   part of the SIP URI (e.g., a SIP registrar). If such an entity
   represents the end of one or more traffic legs, the SIP entity
   inserting the SIP URI can add a SIP URI 'iotl' parameter to the SIP
   URI to indicate the type(s) of traffic leg. Each parameter value
   indicates a type of traffic leg.

   For routing of an initial SIP request for a dialog, or a stand-alone
   SIP request, a SIP entity can add the 'iotl' parameter to (a) the SIP
   URI of the Request-URI [RFC3261] or (b) the SIP URI of a Route header
   field [RFC3261] of the SIP request. SIP entities can add the 'iotl'
   parameter to the SIP URI of a Path header field [RFC3327] or a
   Service-Route header field [RFC3608] in order for the parameter to
   later occur in a Route header field.

   When a SIP entity receives an initial request for a dialog or a
   stand-alone request, which contains one or more SIP URI 'iotl'
   parameters, it identifies the type of traffic leg in the following
   way:

   o if the SIP request contains a single Route header field containing
      a SIP URI with an 'iotl' parameter, that parameter identifies the
      type of traffic leg;

   o if the SIP request contains multiple Route header fields
      containing a SIP URI with an 'iotl' parameter, the 'iotl'
      parameter associated with the SIP URI of the topmost Route header
      field (or, if the SIP URI of the topmost Route header field does
      not contain an 'iotl' parameter, the SIP URI of the Route header
      field closest to the topmost) identifies the type of traffic leg;
      or

   o if a SIP request contains an 'iotl' parameter only in the Request-
      URI SIP URI, the 'iotl' parameter identifies the type of traffic
      leg.

   During SIP registration [RFC3261], entities can add the 'iotl'
   parameter to the SIP URI of a Path or Service-Route header field if
   the entity is aware that the SIP URI will be used to indicate the end
   of a specific traffic leg for initial requests for dialogs or stand-
   alone requests sent on the registration path.

   As defined in [RFC3261], a SIP proxy must not modify or remove URI
   parameters from SIP URIs associated with other entities. This also
   applies to the 'iotl' parameter.

5.2. Parameter Values

5.2.1. General

   This section describes the SIP URI 'iotl' parameter values defined in
   this specification.

   Note that, when a request is routed between different networks, the
   request might traverse one or more IBCFs (Interconnection Border
   Control Functions) acting as network border entities.

5.2.2. homea-homeb

   This value indicates that a SIP entity responsible for the host part
   of the SIP URI associated with the parameter represents the end of a
   traffic leg between the home network (originating) of the calling
   user and the home network (terminating) of the called user.

   In 3GPP, this traffic leg is between two S-CSCFs.

5.2.3. homeb-visitedb

   This value indicates that the SIP entity addressed by the SIP URI
   associated with the parameter represents the end of a traffic leg
   between the home network (terminating) of the called user and the
   visited network (terminating) in which the called user is located.

In 3GPP, this traffic leg is between the home S-CSCF and the User
Equipment (UE) of the called user or between the Service
Centralization and Continuity Application Server (SCC AS) in the home
network of the called user and Access Transfer Control Function
(ATCF) in the visited network of the called user.

5.2.4. visiteda-homea

This value indicates that a SIP entity responsible for the host part
of the SIP URI associated with the parameter represents the end of a
traffic leg between the visited network (originating) in which the
calling user is located and the home network (originating) of the
calling user.

In 3GPP, this traffic leg is between the UE and the home S-CSCF of
the calling user or between the Proxy Call Session Control Function
(P-CSCF) in the visited network, serving the calling user and the
home S-CSCF of the calling user.

5.2.5. homea-visiteda

This value indicates that the SIP entity addressed by the SIP URI
associated with the parameter represents the end of a traffic leg
between the home network (originating) and the visited network
(originating) in which the calling user is located.

In 3GPP, this traffic leg is between the home S-CSCF of the calling
user and the Transit and Roaming Function (TRF) [TS.3GPP.24.229]
serving the calling user and exists in scenarios where the home
S-CSCF of the calling user forwards a request back to the visited
network where the UE of the calling user is located. An example of
this is when the Roaming Architecture for Voice over IMS with Local
Breakout (RAVEL) [TS.3GPP.24.229] feature is enabled.

5.2.6. visiteda-homeb

This value indicates that a SIP entity responsible for the host part
of the SIP URI associated with the parameter represents the end of a
traffic leg between the visited network (originating) of the calling
user and the home network (terminating) of the called user.

In 3GPP, this traffic leg is between the TRF [TS.3GPP.24.229] serving
the calling user and the home S-CSCF of the called user and exists in
scenarios where a request is forwarded from the visited network where
the calling user is located directly to the home S-CSCF of the called
user. An example of this is when the RAVEL [TS.3GPP.24.229] feature
is enabled.

6. Syntax

6.1. General

   This section defines the ABNF for the 'iotl' SIP URI parameter. The
   ABNF defined in this specification is conformant to RFC 5234
   [RFC5234].

   This specification does not create an IANA registry for 'iotl'
   parameter values. A registry should be considered if new parameter
   values are defined in the future.

6.2. ABNF

   The ABNF [RFC5234] grammar for this SIP URI parameter is:

   uri-parameter =/ iotl-param
   iotl-param   = iotl-tag "=" iotl-value ["." iotl-value]
   iotl-tag   = "iotl"
   iotl-value   = "homea-homeb" / "homeb-visitedb" / "visiteda-homea"
                    / "homea-visiteda" / "visiteda-homeb" / other-iotl
   other-iotl   = 1*iotl-char
   iotl-char   = alphanum / "-"
   ;; alphanum defined in RFC 3261

7. Security Considerations

   The information in the 'iotl' parameter is used for making policy
   decisions. Such policies can be related to charging and triggering
   of services. In order to prevent abuse, which could cause user
   billing or service failure, the parameter SHOULD only be used for
   making policy decisions based on the role by nodes within the same
   trust domain [RFC3325], and network boundary entities MUST NOT
   forward information received from untrusted entities. In addition,
   an agreement MUST exist between the operators for usage of the
   roaming role information.

   General security considerations for SIP are defined in [RFC3261]

8. IANA Considerations

   Per this specification, IANA has added one new value to the "SIP/SIPS
   URI Parameters" registry as defined in [RFC3969].

        Parameter Name Predefined Values Reference
        _____
             iotl   Yes   RFC 7549

9. References

9.1. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
                Requirement Levels", BCP 14, RFC 2119,
                DOI 10.17487/RFC2119, March 1997,
                <http://www.rfc-editor.org/info/rfc2119>.

   [RFC3261]   Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston,
                A., Peterson, J., Sparks, R., Handley, M., and E.
                Schooler, "SIP: Session Initiation Protocol", RFC 3261,
                DOI 10.17487/RFC3261, June 2002,
                <http://www.rfc-editor.org/info/rfc3261>.

   [RFC3327]   Willis, D. and B. Hoeneisen, "Session Initiation Protocol
                (SIP) Extension Header Field for Registering Non-Adjacent
                Contacts", RFC 3327, DOI 10.17487/RFC3327, December 2002,
                <http://www.rfc-editor.org/info/rfc3327>.

   [RFC3608]   Willis, D. and B. Hoeneisen, "Session Initiation Protocol
                (SIP) Extension Header Field for Service Route Discovery
                During Registration", RFC 3608, DOI 10.17487/RFC3608,
                October 2003, <http://www.rfc-editor.org/info/rfc3608>.

   [RFC3969]   Camarillo, G., "The Internet Assigned Number Authority
                (IANA) Uniform Resource Identifier (URI) Parameter
                Registry for the Session Initiation Protocol (SIP)", BCP
                99, RFC 3969, DOI 10.17487/RFC3969, December 2004,
                <http://www.rfc-editor.org/info/rfc3969>.

   [RFC5234]   Crocker, D., Ed. and P. Overell, "Augmented BNF for Syntax
                Specifications: ABNF", STD 68, RFC 5234,
                DOI 10.17487/RFC5234, January 2008,
                <http://www.rfc-editor.org/info/rfc5234>.

   [TS.3GPP.24.229]
                3GPP, "Vocabulary for 3GPP Specifications", 3GPP TS 24.229
                12.6.0, September 2014.

9.2. Informative References

   [RFC3325]   Jennings, C., Peterson, J., and M. Watson, "Private
                Extensions to the Session Initiation Protocol (SIP) for
                Asserted Identity within Trusted Networks", RFC 3325,
                DOI 10.17487/RFC3325, November 2002,
                <http://www.rfc-editor.org/info/rfc3325>.

Appendix A. 3GPP Examples

A.1. General

   This section contains example call flows based on 3GPP usage of the
   SIP URI 'iotl' parameter.

A.2. The UE Registers via P-CSCF

   The Visited Proxy (P-CSCF) adds the 'iotl' value 'homeb-visitedb' to
   the Path header field of the REGISTER request to be used for
   terminating routing towards Alice. The Home Proxy (S-CSCF) adds the
   'iotl' value 'visiteda-homea' to the Service-Route header field to be
   used for originating initial/stand-alone requests from Alice.

```
                    Visited Proxy    Visited Proxy      Home Proxy   Home Proxy
Alice's . . . . P-CSCF . . . . . IBCF-V . . . . . IBCF-H . . . . S-CSCF
   |                 |                 |                 |                 |
   |  REGISTER F1    |                 |                 |                 |
   |---------------->|  REGISTER F2    |                 |                 |
   |                 |---------------->|  REGISTER F3    |                 |
   |                 |                 |---------------->|  REGISTER F4    |
   |                 |                 |                 |---------------->|
   |                 |                 |                 |                 |
   |                 |                 |                 |  200 (OK) F5    |
   |                 |                 |                 |<----------------|
   |                 |                 |  200 (OK) F6    |                 |
   |                 |                 |<----------------|                 |
   |                 |  200 (OK) F7    |                 |                 |
   |                 |<----------------|                 |                 |
   |  200 (OK) F8    |                 |                 |                 |
   |<----------------|                 |                 |                 |
```
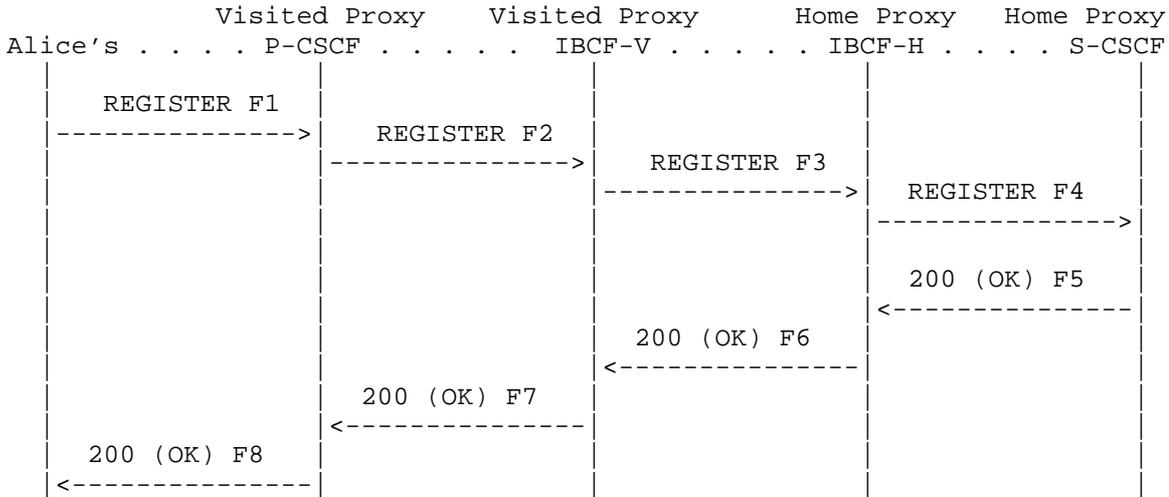

   F1 REGISTER Alice -> P-CSCF
   REGISTER sip:registrar.home1.net SIP/2.0

   F2 REGISTER P-CSCF -> IBCF-V
   REGISTER sip:registrar.home1.net SIP/2.0
   Path: <p-cscf URI;iotl=homeb-visitedb>

   F3 REGISTER IBCF-V -> IBCF-H
   REGISTER sip:registrar.home1.net SIP/2.0
   Path: <p-cscf URI;iotl=homeb-visitedb>

   F4 REGISTER IBCF-H -> S-CSCF
   REGISTER sip:registrar.home1.net SIP/2.0
   Path: <p-cscf URI;iotl=homeb-visitedb>

```
F5 200 OK S-CSCF -> IBCF-H
200 OK
Path: <p-cscf URI;iotl=homeb-visitedb>
Service-Route: <s-cscf URI;iotl=visiteda-homea>

F6 200 OK IBCF-H -> IBCF-V
200 OK
Path: <p-cscf URI;iotl=homeb-visitedb>
Service-Route: <s-cscf URI;iotl=visiteda-homea>

F7 200 OK IBCF-V -> P-CSCF
200 OK
Path: <p-cscf URI;iotl=homeb-visitedb>
Service-Route: <s-cscf URI;iotl=visiteda-homea>

F8 200 OK P-CSCF -> Alice
200 OK
Path: <p-cscf URI;iotl=homeb-visitedb>
Service-Route: <s-cscf URI;iotl=visiteda-homea>
```
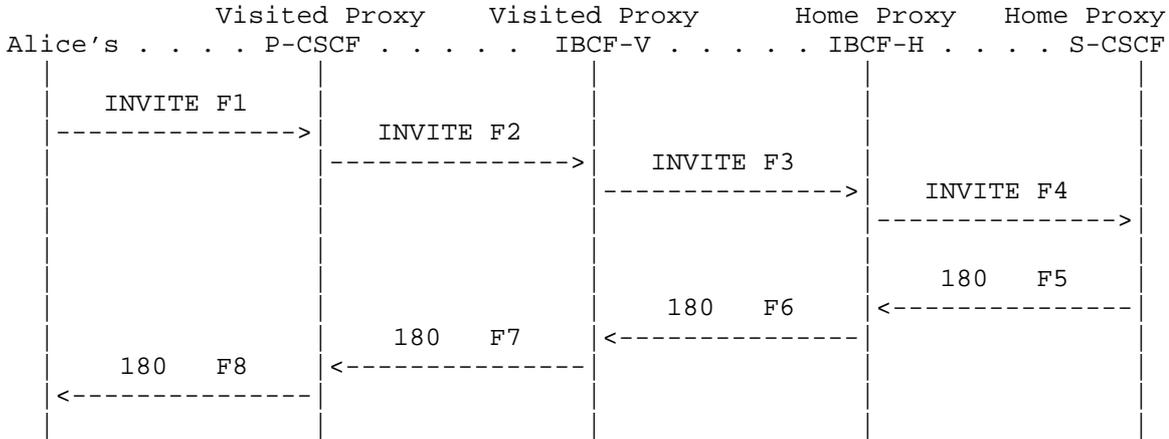
                   Figure 2: The UE Registers via P-CSCF

A.3. Originating IMS Call

   In the originating INVITE request from Alice, the 'iotl' value
   'visiteda-homea', received in the Service-Route header field during
   registration, is added to the Route header field representing the
   Home Proxy (S-CSCF) to indicate the traffic leg type between the
   Visited Proxy (P-CSCF) and the Home Proxy (S-CSCF).

```
             Visited Proxy   Visited Proxy      Home Proxy   Home Proxy
Alice's . . . . P-CSCF . . . . . IBCF-V . . . . . IBCF-H . . . . S-CSCF
  |               |               |               |               |
  |  INVITE F1    |               |               |               |
  |-------------->|  INVITE F2    |               |               |
  |               |-------------->|  INVITE F3    |               |
  |               |               |-------------->|  INVITE F4    |
  |               |               |               |-------------->|
  |               |               |               |               |
  |               |               |               |  180    F5    |
  |               |               |  180    F6    |<--------------|
  |               |  180    F7    |<--------------|               |
  |  180    F8    |<--------------|               |               |
  |<--------------|               |               |               |
  |               |               |               |               |
```

   F1 INVITE Alice -> P-CSCF
   INVITE sip:Bob@homeb.net SIP/2.0
   Route: <p-cscf URI>,<s-cscf URI;iotl=visiteda-homea>

   F2 INVITE P-CSCF -> IBCF-V
   INVITE sip:Bob@homeb.net SIP/2.0
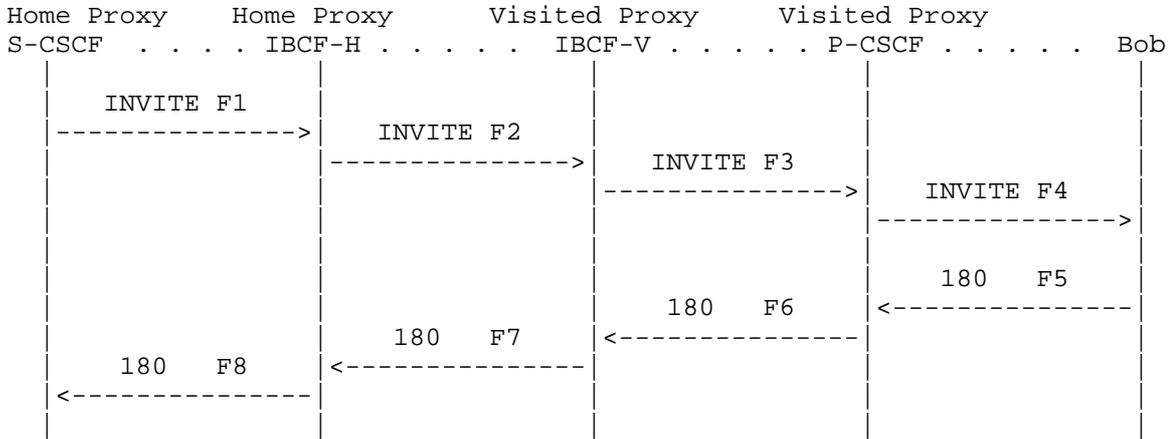   Route: <ibcf-v URI>,<s-cscf URI;iotl=visiteda-homea>

   F3 INVITE IBCF-V -> IBCF-H
   INVITE sip:Bob@homeb.net SIP/2.0
   Route: <ibcf-h URI>,<s-cscf URI;iotl=visiteda-homea>

   F4 INVITE IBCF-H -> S-CSCF
   INVITE sip:Bob@homeb.net SIP/2.0
   Route: <s-cscf URI;iotl=visiteda-homea>

        Figure 3: Originating IP Multimedia Subsystem (IMS) Call

A.4. Terminating IMS Call

   In the terminating INVITE request towards Alice, the 'iotl' value
   'homeb-visitedb' provided to the Home Proxy (S-CSCF) during
   registration is added to the Route header field representing the
   Visited Proxy (P-CSCF) to indicate the traffic leg type between the
   Home Proxy (S-CSCF) and the Visited Proxy (P-CSCF).

```
Home Proxy    Home Proxy      Visited Proxy    Visited Proxy
S-CSCF . . . . IBCF-H . . . . . IBCF-V . . . . . P-CSCF . . . . . Bob
   |             |               |               |               |
   |  INVITE F1  |               |               |               |
   |------------>|   INVITE F2   |               |               |
   |             |-------------->|   INVITE F3   |               |
   |             |               |-------------->|   INVITE F4   |
   |             |               |               |-------------->|
   |             |               |               |               |
   |             |               |               |   180   F5    |
   |             |               |   180   F6    |<--------------|
   |             |   180   F7    |<--------------|               |
   |   180   F8  |<--------------|               |               |
   |<------------|               |               |               |
   |             |               |               |               |
```

   F1 INVITE S-CSCF -> IBCF-H
   INVITE sip:Bob@visitedb.net SIP/2.0
   Route: <ibcf-h URI>,<p-cscf-v URI;iotl=homeb-visitedb

   F2 INVITE IBCF-H -> IBCF-V
   INVITE sip:Bob@visitedb.net SIP/2.0
   Route: <ibcf-v URI>,<p-cscf-v URI;iotl=homeb-visitedb

   F3 INVITE IBCF-V -> P-CSCF
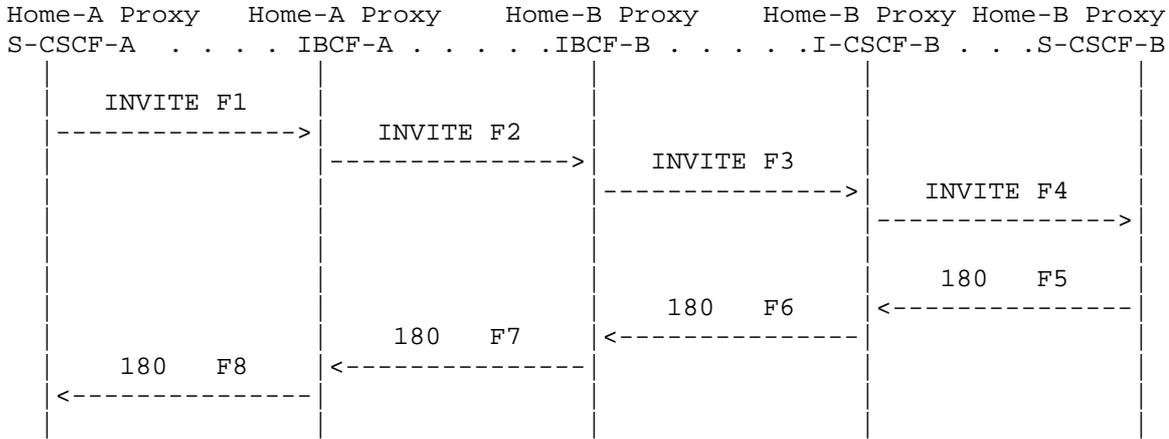   INVITE sip:Bob@visitedb.net SIP/2.0
   Route: <p-cscf-v URI;iotl=homeb-visitedb

   F4 INVITE P-CSCF -> Bob
   INVITE sip:Bob@visitedb.net SIP/2.0

                      Figure 4: Terminating IMS Call

A.5. Call between Originating Home and Terminating Home Network

   The S-CSCF of the originating home network adds the 'iotl' value
   'homea-homeb' in the Request-URI of the INVITE, sent towards the
   S-CSCF of the terminating network to indicate the traffic leg type
   between the S-CSCFs.

```
Home-A Proxy   Home-A Proxy    Home-B Proxy   Home-B Proxy Home-B Proxy
S-CSCF-A  . . . . IBCF-A . . . . .IBCF-B . . . . .I-CSCF-B . . .S-CSCF-B
 |              |              |              |              |
 |    INVITE F1 |              |              |              |
 |------------->|    INVITE F2 |              |              |
 |              |------------->|    INVITE F3 |              |
 |              |              |------------->|    INVITE F4 |
 |              |              |              |------------->|
 |              |              |              |              |
 |              |              |              |    180   F5  |
 |              |              |    180   F6  |<-------------|
 |              |    180   F7  |<-------------|              |
 |    180   F8  |<-------------|              |              |
 |<-------------|              |              |              |
 |              |              |              |              |
```

   F1 INVITE S-CSCF-A -> IBCF-A
   INVITE sip:Bob@visitedb.net;iotl=homea-homeb SIP/2.0

   F2 INVITE IBCF-a -> IBCF-B
   INVITE sip:Bob@visitedb.net;iotl=homea-homeb SIP/2.0

   F3 INVITE IBCF-B -> I-CSCF-B
   INVITE sip:Bob@visitedb.net;iotl=homea-homeb SIP/2.0

   F4 INVITE I-CSCF-B -> S-CSCF-B
   INVITE sip:Bob@visitedb.net;iotl=homea-homeb SIP/2.0

   Figure 5: Call between Originating Home and Terminating Home Network

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